Applicant(x); Elliot ALTMĀN Serial No.: 09 701,947 Filed: 5 December 2000

 $For\ STABILIZED\ BIOACTIVE\ PEPTIDES\ AND\ METHODS\ OF\ IDENTIFICATION,\ SYNTHESIS\ AND$

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- (c) inducing expression of the peptide in the transformed host cell; and
- (d) determining whether expression of the peptide is inhibitory of host cell growth, wherein inhibition of host cell growth is indicative of the expression of a bioactive peptide.
- 61. **(New)** The method of claim 1 wherein the tightly regulable control region of the expression vector comprises at least a portion of the wild-type *E. coli lac* promoter/operator region, said portion comprising auxiliary *lac* operator O3, a CAP binding region, the –35 *lac* promoter site, the –10 *lac* promoter site, *lac* operator O1, *lacZ* Shine-Dalgarno sequence and a spacer region; and wherein the transformed host cell comprises an amount of Lac repressor protein effective to repress expression of the peptide during step (b).
- 62. (New) The method of claim 61 wherein the host cell is a bacterium.
- 63. (New) The method of claim 62 wherein the bacterium is a gram positive bacterium.
- 64. (New) The method of claim 62 wherein the bacterium is gram negative bacterium.
- 65. (New) The method of claim 62 wherein the bacterium is *E. coli*.
- 66. (New) The method of claim 61 wherein the host cell is a microbial pathogen.
- 67. **(New)** The method of claim 66 wherein the microbial pathogen is a member of a genus selected from the group consisting of *Streptococcus*. *Staphylococcus* and *Enterococcus*.
- 68. (New) The method of claim 61 wherein the expression vector comprising the nucleic acid sequence encoding the peptide is a first expression vector, and wherein the host cell

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is further transformed, prior to step (b), with a second expression vector comprising a promoter operably linked to a gene encoding a Lac repressor protein.

- 69. (New) The method of claim 61 wherein the expression vector has the identifying characteristics of pLAC11 (ATCC No. 207108).
- 70. **(New)** The method of claim 69 wherein the expression vector is pLAC11 (ATCC No. 207108).
- 71. (New) The method of claim 1 wherein the host cell comprises proteases or peptidases or both.
- 72. **(New)** The method of claim 1 wherein the host cell has not been modified to reduce or eliminate the expression of naturally expressed proteases or peptidases.
- 73. (New) The method of claim 1 wherein the host cell is a prokaryote.
- 74. (New) The method of claim 1 wherein the host cell is a microbial pathogen.
- 75. **(New)** The method of claim 74 wherein the microbial pathogen is a member of a genus selected from the group consisting of *Streptococcus*, *Staphylococcus* and *Enterococcus*.
- 76. (New) The method of claim 1 wherein the host cell is a eukaryotic cell.
- 77. (New) The method of claim 76 wherein the eukaryotic cell is a mammalian cell.
- 78. (New) The method of claim 76 wherein the eukaryotic cell is a cancer cell.

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- 79. (New) The method of claim 1 wherein the host cell is a protozoan.
- 80. (New) The method of claim 1 wherein the peptide comprises a first stabilizing group comprising the N-terminus of the peptide and a second stabilizing group comprising the C-terminus of the peptide.
- 81. **(New)** The method of claim 80 wherein the first stabilizing group is selected from the group consisting of a small stable protein, Pro-, Pro-Pro-, Xaa-Pro- and Xaa-Pro-Pro-; and wherein the second stabilizing group is selected from the group consisting of a small stable protein, -Pro, -Pro-Pro, -Pro-Xaa and -Pro-Pro-Xaa.
- 82. **(New)** The method of claim 81 wherein the small stable protein is selected from the group consisting of Rop protein, glutathione sulfotransferase, thioredoxin, maltose binding protein and glutathione reductase.
- 83. (New) The method of claim 1 wherein the peptide comprises a stabilizing motif.
- 84. (New) The method of claim 83 wherein the stabilizing motif comprises a hydrophilic α -helix motif.
- 85. (New) The method of claim 83 wherein the stabilizing motif comprises an opposite charge ending motif.
- 86. (New) The method of claim 1 wherein the peptide comprises a randomized amino acid sequence.
- 87. **(New)** The method of claim 86 wherein the peptide comprises a first stabilizing group comprising the N-terminus of the peptide and a second stabilizing group comprising the C-terminus of the peptide.

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- 88. (New) The method of claim 86 wherein the peptide comprises a stabilizing motif.
- 89. (New) A bioactive peptide comprising a first stabilizing group comprising the N-terminus of the bioactive peptide and a second stabilizing group comprising the C-terminus of the bioactive peptide, wherein the first stabilizing group is selected from the group consisting of a small stable protein, Pro-, Pro-Pro-, Xaa-Pro- and Xaa-Pro-Pro-, and wherein the second stabilizing group is selected from the group consisting of a small stable protein, -Pro, -Pro-Pro, -Pro-Xaa and -Pro-Pro-Xaa, with the proviso that when the first stabilizing group is Pro-, the second stabilizing group is not -Pro-Xaa.
- 90. (New) The bioactive peptide of claim 89 wherein the small stable protein is selected from the group consisting of Rop protein, glutathione sulfotransferase, thioredoxin, maltose binding protein, and glutathione reductase.
- 91. **(New)** The bioactive peptide of claim 89 wherein the first stabilizing group is Pro-Pro- and the second stabilizing group is –Pro-Pro.
- 92. (New) The bioactive peptide of claim 89 wherein at least one of the first and second stabilizing groups comprises a small stable protein.
- 93. (New) The bioactive peptide of claim 92 wherein the small stable protein is a four-helix bundle protein.
- 94. (New) The bioactive peptide of claim 92 wherein the small stable protein is selected from the group consisting of Rop protein, glutathione sulfotransferase, thioredoxin, maltose binding protein and glutathione reductase.

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- 95. (New) The bioactive peptide of claim 94 wherein the small stable protein is Rop protein.
- 96. (New) The bioactive peptide of claim 89 which is an antimicrobial peptide.
- 97. (New) The bioactive peptide of claim 89 which is a therapeutic peptide drug.
- 98. (New) A bioactive peptide comprising a plurality of sequential uniformly charged amino acids comprising the N-terminus of the bioactive peptide and a plurality of sequential oppositely charged amino acids comprising the C-terminus of the bioactive peptide.
- 99. (New) A fusion protein comprising a four-helix bundle protein and a polypeptide.
- 100. **(New)** The fusion protein of claim 99 wherein the four-helix bundle protein is Rop protein.
- 101. (New) The fusion protein of claim 100 wherein the polypeptide comprises a bioactive peptide.
- 102. (New) The fusion protein of claim 100 wherein the four-helix bundle protein is covalently linked at its C-terminus to the N-terminus of the polypeptide.
- 103. (New) The fusion protein of claim 100 wherein the four-helix bundle protein is covalently linked at its N-terminus to the C-terminus of the polypeptide.
- 104. (New) A polypeptide comprising:
- a bioactive peptide comprising (a) a first stabilizing group selected from the group consisting of a small stable protein. Pro-, -Pro-Pro-, -Xaa-Pro- and -Xaa-Pro-Pro- and

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(b) a second stabilizing group selected from the group consisting of a small stable protein. –Pro, -Pro-Pro, -Pro-Xaa and -Pro-Pro-Xaa; and

a cleavage site immediately preceding the first stabilizing group: wherein the second stabilizing group comprises the *C*-terminus of the polypeptide.

105. (New) A polypeptide comprising:

a bioactive peptide comprising (a) a first stabilizing group selected from the group consisting of Pro. Pro-Pro-, Xaa-Pro- and Xaa-Pro-Pro- and (b) a second stabilizing group selected from the group consisting of –Pro-, -Pro-Pro-, -Pro-Xaa- and -Pro-Pro-Xaa-; and

a cleavage site immediately following the second stabilizing group: wherein the first stabilizing group comprises the N-terminus of the polypeptide.

106. (New) A polypeptide comprising:

a bioactive peptide comprising a plurality of sequential uniformly charged amino acids comprising the N-terminus of the bioactive peptide and a plurality of sequential oppositely charged amino acids comprising the C-terminus of the bioactive peptide; and

a cleavage site immediately preceding the plurality of sequential uniformly charged amino acids.

107. (New) A polypeptide comprising:

a bioactive peptide comprising a plurality of sequential uniformly charged amino acids comprising the N-terminus of the bioactive peptide and a plurality of sequential oppositely charged amino acids comprising the C-terminus of the bioactive peptide; and

a cleavage site immediately following the plurality of sequential oppositely charged amino acids.

108. (New) A method for using an antimicrobial peptide comprising:

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covalently linking a first stabilizing group to the N-terminus of the antimicrobial peptide and a second stabilizing group to the C-terminus of the antimicrobial peptide to yield a stabilized antimicrobial peptide; and

contacting a microbe with the stabilized antimicrobial peptide.

109. **(New)** The method of claim 108 wherein the first stabilizing group is selected from the group consisting of a small stable protein, Pro-, Pro-Pro-, Xaa-Pro- and Xaa-Pro-Pro-: and wherein the second stabilizing group is selected from the group consisting of a small stable protein, -Pro, -Pro-Pro, -Pro-Xaa and -Pro-Pro-Xaa.

110. **(New)** The method of claim 108 wherein the first stabilizing group is selected from the group consisting of Pro-, Pro-Pro-, Xaa-Pro- and Xaa-Pro-Pro- and the second stabilizing group is selected from the group consisting of -Pro, -Pro-Pro, -Pro-Xaa and -Pro-Pro-Xaa.

111. (New) A method for using an antimicrobial peptide comprising:

covalently linking a plurality of sequential uniformly charged amino acids to the N-terminus of the antimicrobial peptide and covalently linking a plurality of sequential oppositely charged amino acids to the C-terminus of the antimicrobial peptide to yield a stabilized antimicrobial peptide; and

contacting a microbe with the stabilized antimicrobial peptide.

- 112. **(New)** A method for treating a patient having a condition treatable with a peptide drug comprising administering to the patient a stabilized form of the peptide drug.
- 113. **(New)** The method of claim 112 wherein the stabilized form of the peptide drug comprises a first stabilizing group comprising the N-terminus of the peptide drug and a second stabilizing group comprising the C-terminus of the peptide drug.

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114. **(New)** The method of claim 113 wherein the first stabilizing group is selected from the group consisting of a small stable protein, Pro-, Pro-Pro-, Xaa-Pro- and Xaa-Pro-Pro-; and wherein the second stabilizing group is selected from the group consisting of a small stable protein, -Pro, -Pro-Pro, -Pro-Xaa and -Pro-Pro-Xaa.

- 115. (New) The method of claim 114 wherein the small stable protein is a four-helix bundle protein.
- 116. (New) The method of claim 114 wherein the small stable protein is selected from the group consisting of Rop protein, glutathione sulfotransferase, thioredoxin, maltose binding protein and glutathione reductase.
- 117. **(New)** The method of claim 113 further comprising, prior to administration of the stabilized form of the peptide drug, covalently linking the first stabilizing group to the N-terminus of a peptide drug and covalently linking the second stabilizing group to the C-terminus of the peptide drug to yield the stabilized form of the peptide drug.
- 118. (New) The method of claim 112 wherein the stabilized form of the peptide drug comprises an opposite charge ending motif.
- 119. (New) The method of claim 118 further comprising, prior to administration of the stabilized form of the peptide drug, covalently linking a plurality of sequential uniformly charged amino acids to the N-terminus of the peptide drug and covalently linking a plurality of sequential oppositely charged amino acids comprising the C-terminus of the peptide drug to yield the stabilized form of the peptide drug.